DATA STORAGE MEDIUM IN WHICH MULTIPLE BITSTREAMS ARE RECORDED, APPARATUS AND METHOD FOR REPRODUCING THE MULTIPLE BITSTREAMS, AND APPARATUS AND METHOD FOR REPRODUCING THE MULTIPLE BITSTREAMS

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BACKGROUND OF THE INVENTION

1.   Field of the Invention

The present invention relates to the field of recording and reproducing multiple bitstreams, and more particularly, to a data storage medium in which multiple

10   bitstreams are recorded for multimedia data services, an apparatus and method for recording the multiple bitstreams, and an apparatus and method for reproducing the multiple bitstreams.

2.   Description of the Related Art

In conventional multi-media data storage media, different kinds of data such

15   as video data, audio data, and/or extra data including text data are recorded in a multiplexed single bitstream.   Recording apparatuses for recording multimedia data record various kinds of data that constitute multimedia data in a single bitstream by multiplexing.   Accordingly, apparatuses for reproducing multimedia data have only a function of reading and reproducing a single bitstream.

20   Therefore, when there is a need to replace a part of a bitstream recorded by multiplexing, first the multiplexed bitstream is read.   Then, the part of the bitstream is replaced with new data, and the entire bitstream is recorded again.   For example, when a user intends to replace an English caption recorded in a multimedia movie with a Japanese one, the bitstream of the movie is read and recorded again after

25   replacing English caption data included in the bitstream with Japanese caption data. Furthermore, when the user wishes to restore the Japanese caption to the English caption, the English caption data, which was reserved for backup previously, is restored in the same process as for the Japanese caption replacement.

In addition, when there is a need to insert a caption into a recorded movie, the

30   bitstream of the movie is read, multiplexed together with caption data to insert the caption, and recorded again   These processes are relatively burdensome.

SUMMARY OF THE INVENTION

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To solve the above-described problems, it is a first object of the present invention to provide a data storage medium in which various kinds of data constituting multimedia contents are recorded in discrete bitstreams for easy editing and replacement with other data, and an apparatus and method for recording data in multiple bitstreams in a data storage medium.

It is a second object of the present invention to provide an apparatus and method for reproducing data by simultaneously reading multiple bitstreams.

To achieve the first object of the present invention, there is provide a data storage medium comprising: main data including audio data and/or video data; sub data recorded in a separate bitstream from the main data and reproduced in synchronization with the main data; and navigation information defining a relation required for the main data and the sub data to be output in synchronization with each other

It is preferable that the data storage medium further comprises extra data recorded in a separate bitstream from the main data and the sub data and reproduced in association with the main data. In this case, the navigation information may further define a relation required for the main data and the extra data to be output in connection with each other.

It is preferable that the main data, the sub data and/or the extra data are input through a digital interface and recorded.

To achieve the first object of the present invention, there is also provided a recording method comprising: (a) recording main data including audio data and/or video data; (b) recording sub data to be reproduced in synchronization with the main data in a separate bitstream from the main data; and (c) recording navigation information defining a relation required for the main data and the sub data to be reproduced in synchronization with each other.

Preferably, the recording method further comprises: (d) recording extra data to be reproduced in connection with the main data in a separate bitstream from the main data and the sub data; and (e) recording navigation information defining a relation required for the main data and the extra data to be output in connection with each other.

It is preferable that step (a) comprises: (a1) receiving the main data through a digital interface; and (a2) recording the received main data.

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It is preferable that step (b) comprises: (b1) receiving the sub data through the digital interface; and (b2) recording the received sub data.

It is preferable that step (c) comprises: (c1) receiving the extra data through the digital interface; and (c2) recording the received extra data.

To achieve the second object of the present invention, there is provided a reproducing method comprising:(a) reading main data including audio data and/or video data; (b) reading sub data recorded in a separate bitstream from the main data, which is later reproduced in synchronization with the main data; and (c) multiplexing the read main data and the read sub data.

It is preferable that the reproducing method further comprises (d1) outputting the multiplexed main data and sub data through a digital interface, or (d2) decoding the multiplexed main data and sub data.

In the reproducing method, it is preferable that step (c) comprises: (c1) reading navigation information defining a relation required for the read main data and sub data to be reproduced in synchronization with each other; and (c2) multiplexing the read main data and the read sub data based upon the navigation information.

Alternatively, another reproducing method according to the present invention comprises: (a) reading main data including audio data and/or video data; (b) reading sub data recorded in a separate bitstream from the main data, which is later reproduced in synchronization with the main data; (c) reading extra data recorded in a separate bitstream from the main data and the sub data, which is later reproduced in connection with the main data; and (d) multiplexing the read main data, the read sub data, and the read extra data.

In this embodiment, the reproducing method preferably further comprises (e1) outputting the multiplexed main data, sub data, and extra data through a digital interface, or (e2) decoding the multiplexed main data, sub data, and extra data

In the reproducing method above, it is preferable that step (d) comprises: (d1) reading navigation information defining a relation required for the read main data and sub data to be reproduced in synchronization with each other and for the read main data and extra data to be reproduced in connection with each other; and (d2) multiplexing the read main data, the read sub data, and the read extra data based upon the navigation information.

Another embodiment of the reproducing method according to the present invention comprises: (a) reading sub data recorded in a separate bitstream from

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